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CERTIFICATE OF TRANSLATION

As a below named translator, I hereby declare that my residence and citizenship are as stated below next to my name and I hereby certify that I am conversant with both the English and Korean languages and the document enclosed herewith is a true English translation of the Korean patent application No. 1998-10394 filed on March 23, 1998.

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[TITLE OF THE INVENTION]

POWER CONTROL DEVICE AND METHOD IN CDMA COMMUNICATION SYSTEM

[BRIEF DESCRIPTION OF THE DRAWINGS]

FIG. 1 is a diagram illustrating a construction of a channel transmission device for transmitting power control information in a conventional CDMA (Code Division Multiple Access) communication system;

FIGs. 2a through 2c are diagrams illustrating a structure of a common power control channel for transmitting power control information according to an embodiment of the present invention;

FIG. 3 is a diagram illustrating a construction of a common power control channel transmitter for transmitting power control information according to an embodiment of the present invention in a CDMA communication system;

FIG. 4 is a diagram illustrating a construction of a subscriber channel transmitter for transmitting data or control commands in association with the common power control channel according to an embodiment of the present invention in a CDMA communication system;

FIG. 5 is a diagram for explaining the relationship between subscriber channel information and the power control information output from the common power control channel of FIG. 3 and the channel transmitter of FIG. 4; and

FIG. 6 is a diagram illustrating a subscriber channel receiver for receiving the power control information according to an embodiment of the present invention in a CDMA communication system.

[DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS]

[OBJECT OF THE INVENTION]

[RELATED FIELD AND PRIOR ART OF THE INVENTION]

The present invention relates to a power control device and method in a CDMA communication system, and in particular, to a device and method for controlling powers using a common power control channel.

CDMA communication systems based on the IS-95 standard involve transmission of data and power control commands in order to perform a power control. The power control information is inserted into a punctured part of data symbols and spread with the same orthogonal codes as the data symbols for transmission.

FIG. 1 illustrates a construction of a channel transmission device for inserting and transmitting the power control information in the CDMA communication system. The illustrated channel transmission device may be used for a traffic channel or a control channel.

Prior to describing the channel transmission device, for the convenience of explanation, it is assumed that input data is full rate data of a 20ms frame.

A cyclic redundancy check (CRC) generator 111 generates 12 CRC bits and adds the generated CRC bits to 172-bit frame data input, and a tail bit generator 113 generates 8 tail bits and adds the generated tail bits to an end of the CRC-added frame data to enable an encoder 115 in order to initialize the data by the frame unit. When the 172-bit data is input, the data output from the tail bit generator 113 becomes 192-bit data. The encoder 115 then generates 576 symbols per frame by encoding one-frame data output from the tail bit generator

113, and an interleaver 117 interleaves the encoded data output from the encoder 115.

A bit selector 121 decimates a long code output from a long code generator 119 to match the length of the long code to the length of the interleaved encoded data. An XOR gate 123 XORs the interleaved encoded data and the decimated long code to scramble them. After that, a signal convert 125 maps the output signal levels of the XOR gate 123 by converting a signal level "0" to "+1" and a signal level "1" to "-1", and demultiplexes the converted signals by outputting odd-numbered data to a first channel (I-channel) and even-numbered data to a second channel (Q-channel). The I- and Q-channel signals converted are gain controlled in channel gain controllers 133 and 135, respectively.

A control bit gain controller 131 controls a gain of an input power control bit and provides the gain controlled power control bit to puncturers 133 and 135. The puncturers 133 and 135 puncture symbols located at the bit positions designated by a bit selector 121 and insert therein the power control bits output from the control bit gain controller 131. The symbols output from the puncturers 133 and 135 are multiplied by an Walsh code in multipliers 139 and 141, respectively, thus being orthogonally modulated.

However, the number of the available orthogonal codes is limited in the CDMA communication system. In particular, since many traffic channels should be assigned to the users for the data communication service, it is expected that the orthogonal codes will run short. Therefore, when the data communication is temporarily discontinued in the state where the traffic channel is formed, it is preferable to temporarily release an orthogonal code for the channel presently in service and reassign the orthogonal code at the time when the data communication is restarted, so as to increase utility efficiencies of the orthogonal codes.

However, the channel transmission device of FIG. 1 assigns the orthogonal code to transmit the power control command, even when there is no actual data to transmit (in other words, even in the case where data transmission is temporarily discontinued), thus resulting in a waste of the orthogonal codes.

SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to provide a channel reception/transmission device and method for receiving/transmitting power control information in a CDMA communication system.

It is another object of the present invention to provide a device and method for transmitting power control information to subscribers via a common power control channel in a CDMA communication system.

It is further another object of the present invention to provide a channel reception device and method for receiving and processing power control information transmitted through the common power control channel in a CDMA communication system.

To achieve the above object, there is provided a power control channel transmission device in a CDMA communication system including: a slot controller for designating a time slot for transmitting power control commands generated from multiple subscribers; a selector for multiplexing the power control commands by the unit of a power control group under the control of an output of the slot controller; an orthogonal modulator for orthogonally modulating an output signal from the selector by multiplying the output signal of the selector by an orthogonal code of a common power control channel; and a spreading modulator for spreading an output signal from the orthogonal modulator by multiplying the output signal of the orthogonal modulator by a spreading sequence, and transmitting the spread signal.

[CONSTRUCTION AND OPERATION OF THE INVENTION]

Preferred embodiments of the present invention will become described in detail referring to the attached drawings. Like reference numerals denote the same components in the drawings.

In the following description, it would be evident for those who are skilled in the art that, although specific embodiments of the invention are described herein for purpose of illustration in regards to the length of frames transmitted from the respective channels, the coding rate and the number of data and symbols output from the block of each channel, various modifications may be made without deviating from the spirit and scope of the invention.

Use is made of a common control channel in the embodiments of the present invention in order to reduce the number of orthogonal codes used. This means that a single orthogonal code is assigned to the common control channel via which different subscribers receive the orthogonal code to receive/transmit control information. Another spreading code (long code) may be used to identify the respective subscribers. That is, a base station assigns a common orthogonal code to different subscribers via the control channel and a message of the individual subscriber are scrambled by means of a scramble code (for example, a long code) of the subscriber's own. Upon receiving the common control message via the common control channel, the subscriber descrambles the received message and CRC examines whether the message is its own or not. However, this is impossible to achieve when power control command is used for the common control channel, because there is no specific orthogonal code for the subscribers.

To overcome this problem, use is widely made of a common power control channel separated from the common control channel. In assigning a control channel to the subscriber, an orthogonal code for the control channel is assigned to the subscribers and then an orthogonal code and a slot ID for the common power control channel are assigned. Transmission of the power control information via the separate common power control channel makes it possible to transmit the power control command with decreasing the use of the orthogonal code when there exists no data to transmit. Further, the above-mentioned common power control channel structure enables different subscribers to share the same orthogonal code and receive/transmit the corresponding power control information, so that the use of the orthogonal code can be reduced in performing the power control.

FIG. 2a shows a structure of a common power control channel transmitted via the common power control channel according to an embodiment of the present invention. The base station assigns one common orthogonal code to the common power control channel and sends the power control commands to multiple subscribers via this common power control channel. A power control group (hereinafter, called PCG) has a length which is a reciprocal of a transmission frequency of the power control commands. That is, when the power control commands are transmitted 800 times per second, the length of one PCG is 1.25msec (=1/800sec). Further, in the figure, PCC1-PCCM represent the power control commands for the respective subscribers, and one common power control channel can transmit M power control commands in maximum. That is, as shown in FIG. 2, one PCG consists of M power control commands PCC1-PCCM for M subscribers and the PCG is spread with one orthogonal code and transmitted via the common power control channel.

The power control commands PCC1-PCCM for the respective subscribers can be transmitted via the common power control channel by fixing their positions. However, it is preferable to hop the positions of the power control commands to randomly place them within one power control group. In this case, a hopping pattern of the power control commands can be implemented in a similar manner to a method used for implementing the frequency hopping pattern of a FH-SS (Frequency Hopping-Spread Spectrum) system. The hopping pattern of the power control commands is stored in a look-up table.

FIG. 2b shows a look-up table for storing the hopping pattern by which the power control commands are inserted into slots of the common power control channel according to an embodiment of the present invention. In FIG. 2b, the number of the power control commands, M, is assumed to be 8. Numerals in the respective boxes represent slot ID numbers assigned to the subscribers. The positions of the power control commands within one PCG for the common power control channel depend upon the slot ID number and PCG number. FIG. 2c shows a slot hopping pattern for the power control commands, having the slot ID number of 2, in the slot ID look-up table of FIG. 2b.

IF the base station outputs the power control commands for the respective subscribers via the common power control channel in the forward link, the subscribers controls the transmission power of the reverse link according to the power control commands received. Preferably, the mobile stations employ one of the following two receiver types: one is a separate receiver consisting of a common power control channel receiver and a traffic channel receiver; and the other is a shared receiver which receives the power control commands on the common power control channel using the traffic channel receiver.

FIG. 3 illustrates a common power control channel transmitter for transmitting the power control commands to the respective subscribers which share the same orthogonal code and belong to one power control group.

Referring to FIG. 3, the power control commands PCC1-PCCM transmitted to the respective subscribers can be scrambled by user's pseudo-random noise (UPN) sequences. UPNs 311-31M generate unique PN sequences (e.g., long codes) assigned to the respective subscribers. Multipliers 321-32M multiply the power control commands PCC1-PCCM by the corresponding user's PN sequences UPN1-UPNM, respectively, to generate scrambled power control commands.

The respective power control commands are multiplied by different gains and then transmitted to the corresponding subscribers. Gain controllers 331-33M receive the power control commands output from the corresponding multipliers 321-32M and control gains of the received power control commands according to corresponding gain control signals.

The locations of the assigned power control commands can be fixed on the common power control channel. Alternatively, the locations of the power control commands can be varied at the respective PCGs to provide a uniform spectrum. A slot controller 340 generates a control signal for determining the slot positions into which the power control commands output via the common power control channel are inserted. The slot controller 340 includes the slot hopping look-up pattern table structured as shown in FIG. 2b, generating a slot control signal for designating time slots into which the power control commands for the respective subscribers are inserted, by consulting the slot hopping pattern table.

A selector 350 receives the gain controlled power control commands PCC1-PCCM and multiplexes the received power control commands according to the slot control signal output from the slot controller 340. That is, the selector 350, under the control of the slot control signal output form the slot controller 340, selects one of the power control commands PCC1-PCCM and outputs the selected power control command to the common power control channel. A multiplexer can be sued for the selector 350.

An orthogonal modulator is composed of an orthogonal code generator 361 and a multiplier 362. The orthogonal code generator 361 generates an orthogonal code for orthogonally modulating the power control commands transmitted through the common power control channel, and the multiplier 362 multiplies the power control commands for the respective subscribers output from the selector 350 by the orthogonal code. That is, the orthogonal modulator modulates the power control commands for several subscribers using one orthogonal code and outputs the orthogonally modulated power control commands to the common power control channel.

A spreading modulator is composed of a spreading sequence generator 371 and a multiplier 372. The spreading sequence generator 371 generates a spreading sequence for spreading the orthogonally modulated signals. The multiplier 372 multiplies the orthogonally modulated signals by the spreading sequence to spread the power control commands, and then outputs the spread power control commands via the common power control channel.

Although the orthogonal modulator and the spreading modulator employ binary phase shift keying (BPSK) modulation in the figure, they may also employ quadrature phase shift keying (QPSK) modulation. In this case, the power control commands output from the selector 350 are demultiplexed and output as odd-numbered power control commands to a first channel and as even-numbered power control commands to a second channel. Thereafter, the divided channel signals are separately subjected to the orthogonal modulation and the spreading modulation.

In the exemplary embodiment, the power control commands transmitted to the respected subscribers via the common power control channel are scrambled with the corresponding user's PN sequences UPN1-UPNM and output to the corresponding gain controllers 331-33M. The scheme for scrambling the power control commands with the user's PN sequences may be removed, in which case, power control commands PCC1-PCCM are directly applied to the corresponding gain controllers 331-33M. The gain controllers 331-33M then multiply the received power control commands by the corresponding gains and output them to the selector 350.

The slot controller 340 designates the time slots for arranging the power control commands to be transmitted to the respective subscribers, on the common power control channel. As shown in FIG. 2a, the slot controller 340 assigns the positions of the respective power control commands for the respective power control groups. There are known two methods for assigning the power control commands: one is to fix the positions of the power control commands and another is to vary the positions for the respective PCGs. In the embodiment, the slot controller 340 includes the slot hopping pattern look-up table of FIG. 2b and variably designates the insert positions of the power control commands for the respective subscribers. The selector 350 assigns the power control commands output from the gain controllers 331-33M to the specified locations according to the slot control signal output from the slot controller 340, as shown in FIG. 2.

The power control commands are then multiplied by the orthogonal code in the multiplier 362 to be orthogonally modulated and again multiplied by the spreading sequence in the multiplier 372 to be spread.

The power control commands are separately transmitted to the respective subscribers via the common power control channel as shown in FIG. 3 irrespective of the traffic channel and the control channel. The traffic channel includes a fundamental channel for voice transmission and a supplemental channel for packet data transmission, while the control channel is a channel for transmitting control signals related to the communication.

The device for receiving the power control commands for the common power control channel can be implemented by a separate receiver or a shared receiver, as previously described. The separate receiver refers to a receiver which receives the power control commands independently via the common power control channel and the traffic/control channel. The separate receiver must have a construction for separately demodulating information concerning the traffic channel (or control channel) and the common power control channel. The separate receiver also refers to a channel receiver which demodulates both power control information and corresponding channel information in association with the common power control channel. It is assumed in this embodiment of the present invention that the receiver for the common power control commands is the shared receiver, in which case the channel for receiving the power control commands of the common power control channel is the traffic channel.

FIG. 4 shows a structure of a channel transmitter which corresponds to the channel receiver for receiving the channel information in association with the power control commands according to an embodiment of the present invention.

Referring to FIG. 4, a CRC generator 111 generates CRC bits and adds them to the input frame data. A tail bit generator 113 generates tail bits for representing termination of one frame data and adds the generated tail bits to the frame data output from the CRC generator 111. An encoder 115 encodes the frame data output from the tail bit generator 113. A convolutional encoder or a turbo encoder may be used for the encoder 115. The encoder 115 is a convolutional encoder which has a coding rate of 1/3 and a constraint length, K=9. An interleaver 117 interleaves an output of the encoder 115. A block interleaver can be used for the interleaver 117.

A long code generator 119 generates a long code for use in scrambling user information. Here, the long code is a unique user identification code and corresponds to the user's PN sequence in the transmitter. A decimator 121 decimates the long code to match a rate of the symbols output from the interleaver 117 to a rate of the long code. An XOR gate 123 XORs the encoded symbols output from the interleaver 117 and the decimated long code.

A demultiplexing and signal power mapping part 125 demultiplexes the data output from the XOR gate 123 into I-channel (i.e., first channel) data and

Q-channel (i.e., second channel) data, and maps signal levels of the symbol data by converting data of "0" to "+1" and data of "1" to "-1". A channel gain controller 127 receives the first channel data and controls a gain of the received first channel data according to a gain control signal. A channel gain controller 129 receives the second channel data and control a gain of the received second channel data according to a gain control signal.

A puncture position controller 400 generates a puncture position control signal for puncturing the symbols on the traffic channel corresponding to the slot positions into which the power control commands for the corresponding subscriber are inserted. The puncture position controller 400 generates the puncture position control signal in the same manner as the slot controller 340 of FIG. 6. The puncture position control signal is generated for a symbol data duration of one frame based on the slot hopping pattern look-up table of FIG. 2b. A first puncturer 133 receives the data symbols output from the channel gain controller 127 and punctures (or deletes) the data symbols according to the puncture position control signal output from the puncture position controller 400. A second puncturer 135 receives the data symbols output from the channel gain controller 129 and punctures the data symbols according to the puncture position control signal output from the puncture position controller 400. That is, the puncturers 133 and 135 receive the data symbols output from the channel gain controllers 127 and 129, and puncture the data symbols located at the positions corresponding to the puncture position control signal output from the puncture position controller 400. As a result, the puncturers 133 and 135 output the first and second channel symbol data, with the symbols located at the time slots for the power control commands being punctured.

An orthogonal code generator 137 generates an orthogonal code according to a Walsh code number Wno and a Walsh code length Wlength. A multiplier 139 multiplies the first channel data symbols output from the first puncturer 133 by the orthogonal code to generate an orthogonally modulated signal for the first channel. A multiplier 141 multiplies the second channel data symbols output from the second puncturer 135 by the orthogonal code to generate an orthogonally modulated signal for the second channel. A PNI generator 143 generates a PN sequence PNI for the first channel (i.e., I-channel). A multiplier 145 multiplies the orthogonal modulation signal output from the multiplier 139 by the PNI sequence to generate a spread signal for the first channel. A PNQ generator 147 generates a PN sequence PNQ for the second channel (i.e., Q-channel). A multiplier 149 multiplies the orthogonal modulation signal output from the multiplier 141 by the PNQ sequence to generate a spread signal for the second channel.

For the convenience of explanation, it will be assumed that the receiver for demodulating the power control commands received from the common power control channel is a fundamental channel receiver. In this case, the channel transmitter structured as shown in FIG. 4 is a fundamental channel transmitter.

Reference will now made to the description of the operation of the channel transmitter which is associated with the power control commands transmitted via the common power control channel according to the embodiment of the present invention, in connection with FIG. 4. Here, the channel transmitter is a fundamental channel transmitter and input data is full rate data of 20 ms frame.

The CRC generator 111 adds the CRC bits to the input frame data in order to enable a receiver to determine a quality of the frame. If one input frame has a length of 172 bits, the CRC generator 111 generates 12 CRC bits and adds them to the input frame data.

The CRC bit-added frame data is applied to the tail bit generator 113 which generates 8 tail bits per frame and adds them to the CRC bit-added frame data. The tail bits are used to represent termination of one frame and serve to initialize the encoder 115 at the following stage of the tail bit generator 113. It is assumed that the encoder 115 used in the embodiment is a convolutional encoder having a constraint length, K=9, and a coding rate, R=1/3. In this case, the encoder 115 encodes 192 bits per frame into 576 symbols per frame. The interleaver 117 receives 576 symbols per frame output from the encoder 115 and rearranges the bits within the frame by the frame unit to increase a tolerance against the burst error.

The long code generator 119 generates a long code differently assigned to each user, which scrambles the user's information. The decimator 121 decimates the long code output from the long code generator 119 to match a rate of the long code to that of the symbols output from the interleaver 117. The XOR gate 123 XORs the interleaved signal and the decimated long code to scramble the interleaved signal.

The demultiplexing and signal power mapping part 125 demultiplexes the symbols output form the XOR gate 123 to output the odd-numbered symbols to the first channel and the even-numbered symbols to the second channel. Also, the demultiplexing and signal power mapping part 125 maps signal levels by converting a signal level "1" to "-1" and a signal level "0" to "+1". The channel gain controllers 127 and 129 control gains of the symbols for the first and second channels, respectively.

The puncturers 133 and 135 then puncture the symbols located at the positions of the power control commands on the common power control channel, under the control of the puncture position controller 400. That is, the puncture position controller 400 designates the symbol puncture positions corresponding to the positions of the power control commands for the corresponding subscriber on the common power control channel, in the same manner as the slot controller 340. The puncturers 133 and 135 then puncture the designated symbols for the first and second channels, respectively.

FIG. 5 is a diagram for explaining a relationship between the power control commands output from the common power control channel and the symbols of the fundamental channel. Reference numeral 511 denotes a power control command channel having M power control commands PCC1-PCCM for M subscribers, wherein PCCi represents the power control command for i-th subscriber. Reference numeral 513 denotes a fundamental channel in which a symbol corresponding to the power control command PCCi is deleted.

The multiplier 139 multiplies the symbols output from the puncture 133 by the orthogonal code output from the orthogonal code generator 137 to generate orthogonally modulated transmission signals for the first channel, and the multiplier 141 multiplies the symbols output from the puncture 135 by the orthogonal code output from the orthogonal code generator 137 to generate orthogonally modulated transmission signals for the second channel. The orthogonal code used in the channel transmitter is a Walsh code or a quasi-orthogonal code. In addition, the multipliers 145 and 149 multiply the orthogonally modulated signals for the first and second channels by the PN sequences PNI and PNQ, respectively, to spread the orthogonally modulated signals.

In a case where a specific channel transmitter sends the channel information in association with the common power control channel as shown in FIG. 5, the channel receiver corresponding to the channel may be constructed as illustrated in FIG. 6, which shows a structure of a shared receiver.

Referring to FIG. 6, a spreading sequence generator 611 generates a spreading sequence for despreading a received spread signal. A PN sequence can be used for the spreading sequence. A multiplier 613 multiplies the input spread signal by the spreading sequence to despread the input spread signal.

A PCC bit position selector 615 generates a position select signal for selecting a slot into which the power control command for the corresponding subscriber is inserted. A first orthogonal code generator 617 generates an orthogonal code Wdt assigned to the traffic channel for the corresponding subscriber, and a second orthogonal code generator 619 generates an orthogonal code Wsp assigned to the common power control channel. Here, the orthogonal code Wsp generated from the second orthogonal code generator 619 is assigned in common to several subscribers receiving the power control commands transmitted via the common power control channel for the forward link. A switch 621 selects the orthogonal code Wdt or the orthogonal code Wsp according to the position select signal output from the PCC bit position selector 615. A multiplier 623 multiplies the despread signal output from the multiplier 613 by the orthogonal code selected in the switch 621, to demodulate the orthogonally modulated signal. An accumulator 625 accumulates an output of the multiplier 623. This structure corresponds to a subscriber channel receiver associated with the common power control channel.

A third orthogonal code generator 631 generates an orthogonal code Wpi for the pilot channel. A multiplier 633 multiplies an output of the multiplier 613 by the orthogonal code Wpi for the pilot channel, to generate a pilot channel signal. A channel estimator 635 estimates an energy of the pilot signal by receiving an output of the multiplier 633. A complex conjugator 637 calculates a complex conjugate by receiving an output of the channel estimator 635. This structure corresponds to a pilot channel receiver.

A multiplier 627 multiplies an output of the complex conjugator 637 by an output of the accumulator 625. A switch 629 switches an output of the multiplier 627 to the data channel or the power control channel according to the position select signal from the PCC bit position selector 615.

In operation, the subscriber channel receiver structured as described above receives information on both the corresponding subscriber channel and the common power control channel. The multiplier 613 despreads the received signal which was spread during transmission, by multiplying the received signal by the spreading sequence generated from the spreading sequence generator 611. The despread signal is again multiplied in the multiplier 633 by the orthogonal code Wpi for the pilot channel. In the way, the multiplier 633 extracts the pilot channel signal from the receive signal. The channel estimator 635 estimates the pilot channel signal to determine the pilot channel condition. The estimated pilot channel signal is applied to the multiplier 627 through the complex conjugator 637. In doing so, the pilot channel signal is demodulated in the same way as in a common pilot channel receiver.

It is however necessary to generate a first orthogonal code Wdt for receiving a subscriber traffic channel signal associated with the common power control channel and a second orthogonal code Wsp for receiving the power control information of the common power control channel. The first and second orthogonal codes Wdt and Wsp are orthogonal codes assigned in communication. Especially, the first orthogonal code is an orthogonal code exclusively assigned to the corresponding subscribers, while the second orthogonal code is an orthogonal code commonly assigned to different subscribers that receive the power control commands via the common power control channel. The base station releases the first orthogonal code Wdt when the communication is discontinued, and reassigns it when the communication reassumes. The numeral representing the first orthogonal code may change during communication. The second orthogonal code Wsp is assigned in setting up a call and uses the same numeral until the communication terminates.

The subscriber channel receiver receives positional information about the slot into which the power control command for the corresponding subscriber is inserted and orthogonal code information about the common power control channel. The PCC bit position selector 615 has the slot hopping pattern look-up table structured as shown in FIG. 2b. Therefore, the PCC bit position selector 615 can detect the slot into which the power control command for the corresponding subscriber is inserted, based on the received positional information and the look-up table. In other words, it is possible to detect the position of the symbol punctured as shown in FIG. 5. The PCC bit position selector 615 generates the position select signal for controlling the switches 621 and 629 at the position of the punctured symbol. The switch 621 is normally connected to an output node of the first orthogonal code generator 617, and is switched to an output node of the second orthogonal code generator 619 in response to the position select signal generated from the PCC bit position selector 615. Similarly, the switch 629 is normally connected to an input node of a data combiner (not shown), and is switched to an input node of a power control command combiner (not shown) in response to the position select signal generated from the PCC bit position selector 615.

As a result, for the symbol data processing interval, the despread signal output from the multiplier 613 is multiplied in the multiplier 623 by the first orthogonal code Wdt to be demodulated, and then accumulated in the accumulator 625. The output of the accumulator 625 is compensated in the multiplier 627 and then applied to the data combiner via the switch 629. During the symbol data processing, if the PCC bit position selector 615 generates the position select signal, the switch 621 is switched to the output node of the second orthogonal code generator 619 and the switch 629 is switched to the input node of the power control command combiner. As a result, the power control command for the corresponding subscriber is multiplied in the multiplier 623 by the second orthogonal code Wsp to be demodulated, and then applied to the power control command combiner via the accumulator 625, the multiplier 627 and the switch 629.

In sum, the subscriber channel receiver generates two separate orthogonal codes: one for demodulating the subscriber channel information and another for demodulating the power control command. That is, the subscriber channel receiver selects the orthogonal code for the subscriber channel to demodulate the symbol data, and selects the orthogonal code for the common power control channel to demodulate the power control command. Here, since the symbol on the subscriber channel located at the position corresponding to the power control command for the subscriber is punctured, there is no influence of the symbols in demodulating the power control command at the receiver.

The first orthogonal code Wdt is released when the communication through the subscriber channels is temporarily discontinued, in which case the second orthogonal code is still assigned for demodulating the power control commands of the common power control channel. Accordingly, the subscriber channel receiver processes the power control commands normally with the communication interrupted. If the communicates terminates completely, the second orthogonal code is also released.

[EFFECT OF THE INVENTION]

In the light of the foregoing descriptions, the present invention enables the CDMA communication system to use the orthogonal code efficiently since the system can transmit the power control information of multiple subscribers via the common power control channel using a single orthogonal code. In addition, even when there exists no transmission data of the subscribers, the power control commands can be transmitted with the reduced number of the orthogonal code being used.